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FOREST CONDITIONS REPORT
FOR
GREENBELT NATIONAL PARK
USDI NATIONAL PARK SERVICE

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ABSTRACT

In 1990, significant tree mortality occurred in the area west of the Baltimore-Washington Parkway within the boundaries of Greenbelt National Park, Maryland. Within the affected area, the oak component suffered the heaviest mortality with most of the mortality occurring in the white oak group (Quercus alba). Stand density in terms of basal area was reduced from a fully stocked stand of 95 square feet per acre to an understocked stand of 60 square feet per acre. Stand density in terms of trees per acre was reduced by 29 percent overall and by 53 percent among the oaks. The tree mortality which occurred in this area is contributed to the combined effect of a preceding 5 year drought and moderate-heavy defoliation which occurred during the 1989-90 gypsy moth outbreak. The residual forest has somewhat of a more uniform distribution of size classes than the previous forest and the crown conditions of the remaining oaks were rated as being healthy.

INTRODUCTION

Greenbelt National Park is located in Prince George's County, Maryland, between the cities of College Park and Greenbelt. The Park consists of approximately 1,166 acres of which about 1,100 acres are forested. The Park serves the Washington, DC metropolitan area and is used primarily for day use activities (i.e. picnics, hiking, birdwatching, etc.) although some overnight camping is available.

In 1989, the primary tree species in the Park included white oak (Quercus alba) - 32 percent; Virginia pine (Pinus virginiana) - 17 percent; scarlet oak (Q. coccinea) - 8 percent; and black gum (Nyssa sylvatica var. sylvatica) - 8 percent, which together comprised 65 percent of the species composition. Other oak species found within the Park included chestnut oak (Q. prinus), northern red oak (Q. rubra), black oak (Q. velutina), southern red oak (Q. falcata var. falcata), and willow oak (Q. phellos) which together comprised an additional 20 percent of the oak component and species composition. The remaining 15 percent of associated species included red maple (Acer rubra), sweetgum (Liquidambar styraciflua), American beech (Fagus grandifolia), yellow poplar (Liriodendron tulipifera) as well as a few other uncommon species which collectively made up less than one percent of the species composition.

As a result of the tree mortality that occurred in 1989-90, species composition and stocking levels were significantly affected. The existing forest stand and the changes that occurred are discussed in detail in this report.

METHODS

Acreage figures for both defoliation and tree mortality estimates were determined by using 1:6000 scale color infrared aerial photography. The aerial photos were taken in 1989 and again in 1990 in early July which coincides with peak gypsy moth defoliation. Defoliation was observed in both 1989 and 1990 and was classified as moderate when 31-60 percent of the foliage from the trees in a given area was defoliated, and heavy when 61-100 percent of the foliage in a given area was defoliated.

Extensive tree mortality was first observed in 1990. The mortality was delineated from the 1990 aerial photography and was categorized 11-25 percent and greater than 25 percent or moderate and heavy, respectively.

In August of 1990, a ground survey was conducted to evaluate the intensity of the tree mortality. The ground survey consisted of 44 plots, 40 of which were randomly distributed in the area of west of the Baltimore-Washington Parkway. The plots consisted of 10-factor prism points in which tree species, tree diameter, basal area, crown class, and the crown condition of all oak trees were recorded.

Tree diameter was measured at 4.5 feet (diameter breast high) above the highest ground level on the bole of the tree. The measured diameter was then recorded in 2 inch size classes (i.e. 1.0-3.99 inch diameter = 2 inch size class; 4.0-5.99 = 4 inch size class, etc.)

Basal area was measured by using a 10-factor prism and all "in" trees were recorded for each plot. Basal area is the area in square feet of the cross section of a tree at breast height. Each tree recorded represents 10 square feet of basal area per acre.

Crown class was determined by categorizing the tree's position in the forest canopy. The following four crown classes were used: 1) dominant, when crowns extended above the general crown canopy such that the top and most of the sides of the crown receive full sunlight; 2) co-dominant, trees with crowns forming the general level of the canopy and receive full light from above and very little on the sides; 3) intermediate, trees shorter than the previous two classes but with crowns extending into and receiving some light from above but none on the sides; and 4) suppressed, trees that are completely overtopped and receive no direct light either from above or the sides.

Crown condition was determined by using a subjective rating scheme of 1 for trees having 25 percent or less branch dieback, 2 for trees having between 26-50 percent dieback, 3 for trees containing greater than 50 percent dieback, and 4 for dead trees. Only the crowns of oak trees were evaluated.

RESULTS

Photo Interpretation

During the two year outbreak of gypsy moth in the Park, 120 acres of heavy (61-100 percent) defoliation and 79 acres of moderate (31-60 percent) defoliation occurred in 1989 and 30 acres of moderate defoliation was observed in 1990 (Figure 1). More than 90 percent of the defoliation occurred west of the Baltimore-Washington Parkway. (Figure 1). Less than 3 percent of this area was defoliated in both years.

Significant tree mortality was observed on approximately 95 acres in the Park. Of this, 30 acres were rated as moderate mortality (11-25 percent) and 65 acres as heavy mortality (greater than 25 percent). All but about 2 acres of tree mortality occurred west of the Baltimore-Washington Parkway. Less than 2 percent of the total area that was defoliated in both 1989-90 had significant tree mortality. Approximately 17 acres containing tree mortality had no defoliation occur in either 1989 or 1990.

Ground Survey

A total of 40 survey plots was conducted in the wooded area west of the Baltimore-Washington Parkway inside the park. This area consists of approximately 876 acres and contained virtually all but 3 percent of the tree mortality that occurred in 1990 (Figure 2). In this area, 29 percent of the trees inventoried were dead and of these, 91 percent were oaks. The other 9 percent of the dead trees included Virginia pine, hickory and sassafrass.

Figures 3 and 4 reflect the changes that occurred in the stand in terms of species composition and basal area. One of the most significant changes was the shift in species composition from a stand that was predominantly white oaks to a stand that is now predominantly Virginia pine. White oaks made up 32 percent of the total trees/acre and 35 percent of the basal area in the original stand. White oaks in the residual stand now make up only 14 percent of the trees/acre and 14 percent of the total basal area. Virginia pine, on the other hand, moved from a 17 to a 22 percent position in the stands species composition and from a 14 to a 20 percent position of the stands total basal area.

Figure 5 shows the changes that occurred in the diameter size classes. The changes include a shift from the majority of trees in the small sawtimber size class (12-16 inches dbh) to the majority now being in the pole size class (6-10 inches dbh). Looking at the oak component separately (Figure 5), we see that the majority of oaks are still in the small and large (12-16 and 18+ dbh, respectively) size classes. This may be due in part because the oaks were not well represented in the smaller size classes in the original stand.

The average crown class of the stand and the average crown condition of the stand is shown in Table 1. The crown class of the original residual oak trees prior to the tree mortality included primarily co-dominant/dominant trees with an average rating of 2.2. Following the tree mortality which removed mainly dominant and to a lesser extent co-dominant trees (average crown class of dead trees = 1.2) the residual stand now consists of co-dominant/intermediate trees with an average crown class of 2.6. The average crown condition of the oak trees in the residual stand was rated at 1.4, or good.

CONCLUSION

Although no on-site rainfall data was collected, data from 1981-90 collected at the Washington National Airport which is approximately 9 miles southwest of the Park was reviewed (Table 2). From 1985-88, prior to the first defoliation, a rainfall deficit of 19.16 inches existed with the largest single-year deficit occurring in 1988 (7.26 inches). These droughty conditions compounded by the gypsy moth caused tree defoliation are the primary cause of the extensive tree mortality that occurred in Greenbelt National Park. There was apporoximately 15 acres of tree mortality that occurred that was not associated with any observable defoliation. This may have been the result of: human error in estimating the extent of the defoliation; a different unknown causal agent was involved; and/or the droughty conditions alone was enough to cause the trees to die.

The vast majority of the tree mortality involved oaks, primarily white oaks. The white oaks suffered the most mortality because they not only made up the largest component of the original stand, but are also one of the most preferred foods of the gypsy moth. The largest species component of the residual stands basal area is now Virginia pine (20 percent). Although the oak group still makes up 56 percent of the total residual basal area, approximately 28 oak trees per acre (47 percent) were killed.

The changes in the forest that occurred as a result of the tree mortality at the Park may be perceived as having both negative and positive impacts. Some of the negative impacts include:

- Reduced hard mast production - some of the larger more mature oak trees that died probably produced the largest quantity of hard mast.
- Increased number of hazard trees which ~~consequently~~ may require removal.
- Users may find it more difficult to walk through the forest due to the increased understory (greenbrier, etc.) that will develop as a result of the increased sunlight reaching the forest floor.
- Visitors may find the Park less aesthetically pleasing because of the large number of visible dead trees and loss of the "park-like" appearance.

Some of the more positive changes that have occurred however, include:

- The residual stand should be somewhat more resistant to future gypsy moth outbreaks since the reduced numbers of oak trees would reduce the potential or at least the severity of defoliation.
- The residual stand should also be more resistant to future tree mortality since the crown condition of the residual trees is good, indicating the relative good health of the trees. It is likely that most of the trees that died were under the greatest stress, had the poorest crown conditions and consequently were ~~less able to withstand any further stress~~ more vulnerable to mortality.
- An increase in the understory vegetation will create a more diverse habitat for wildlife by providing more cover and an increase in soft mast production.
- The dead trees will provide a large number of den trees.

It should prove interesting to monitor the conditions of the forest within Greenbelt Park in the future. With a lot of the overstory killed, some areas will be in an earlier successional stage which ~~will make for a much~~ single-aged stand more dynamic state than the previous older growth forest. Short of another major disruption, such as that caused by the recent drought and gypsy moth defoliation, the forest at Greenbelt Park should recover to its previous density within the next 10-15 years. In the interim, it is expected that the number of seedlings and saplings will increase as a result of the increased available sunlight to the forest floor. An increase in the number of trees in the lower size classes will likely be at a more rapid rate than trees moving into the next larger size class. If this occurs, it will result in a more uniform overall distribution of size classes and could very well produce a more sustainable, more diverse and potentially healthier forest within Greenbelt Park.

Table 1.--Average crown class and crown conditions of the trees at Greenbelt National Park, Maryland - 1990.

	Average Crown Class*	Average Crown Condition**
Original Stand	2.2	---
Residual Stand	2.6	1.4
Dead Trees Only	1.2	---

*Crown class was rated on all tree species as follows: 1 = Dominant; 2 = Co-dominant; 3 = Intermediate; 4 = Suppressed

**Crown condition was rated only on oaks as follows: 1 = Good (<25% branch dieback); 2 = Fair (26-49% branch dieback); 3 = Poor (>50% branch dieback); 4 = Dead

Table 2.--1981-90 Precipitation data collected at Washington National Airport\1

Year	Precipitation (Inches)	Difference from Normal\2	Cumulative Difference from Normal
1981	30.67	-8.33	-8.33
1982	35.77	-3.23	-11.23
1983	51.87	+12.87	+1.31
1984	37.73	-1.27	+0.04
1985	35.86	-3.14	-3.10
1986	32.57	-6.43	-9.53
1987	36.63	-2.37	-11.90
1988	31.74	-7.26	-19.16
1989	50.32	+11.32	-7.84
1990	40.84	+1.84	-6.00

1/ Data provided by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration

2/ 30 year average rainfall = 39.00 inches per year.

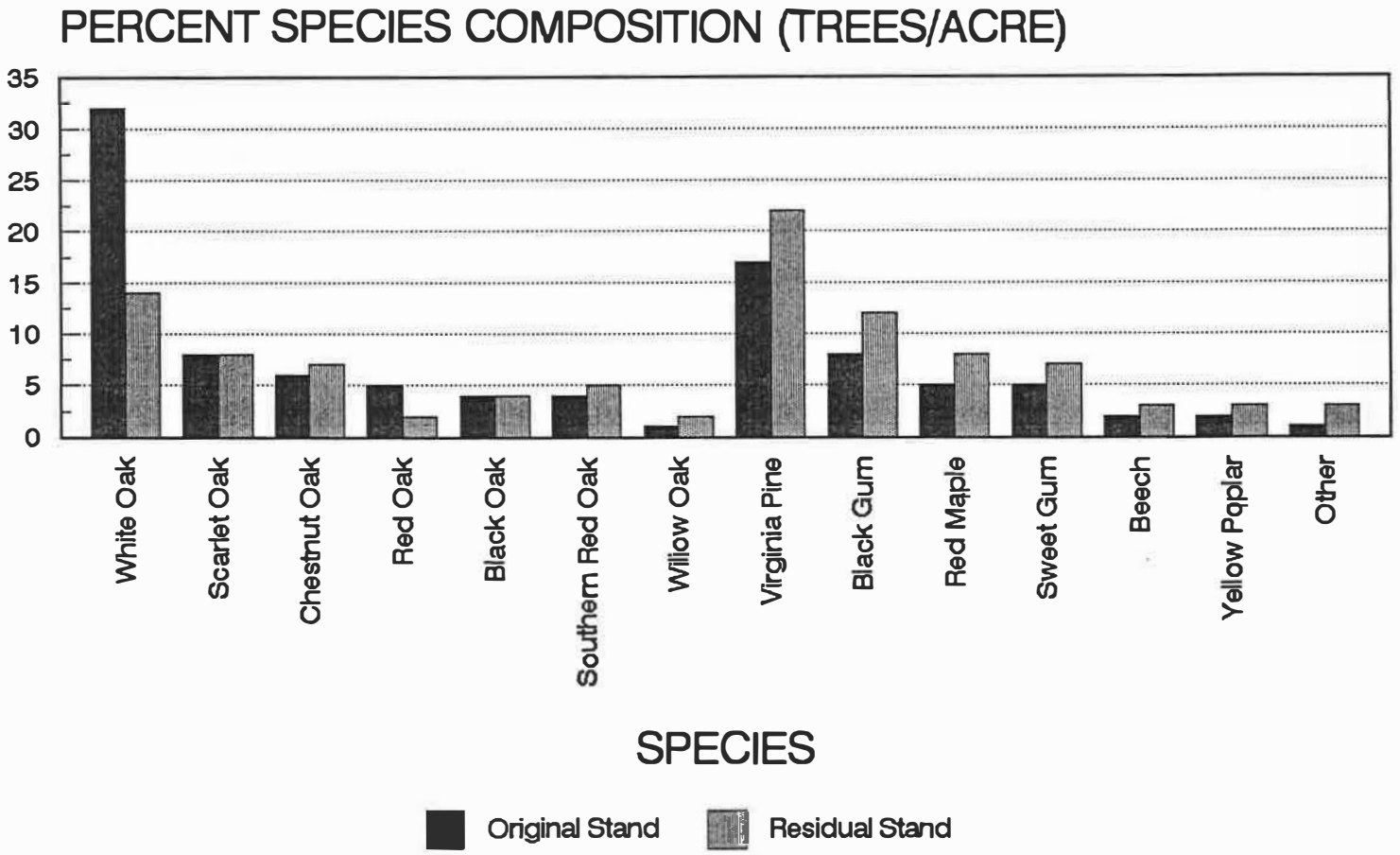

Figure 3. Percent Change In Species Composition Following the 1990 Tree Mortality At Greenbelt National Park, Md.

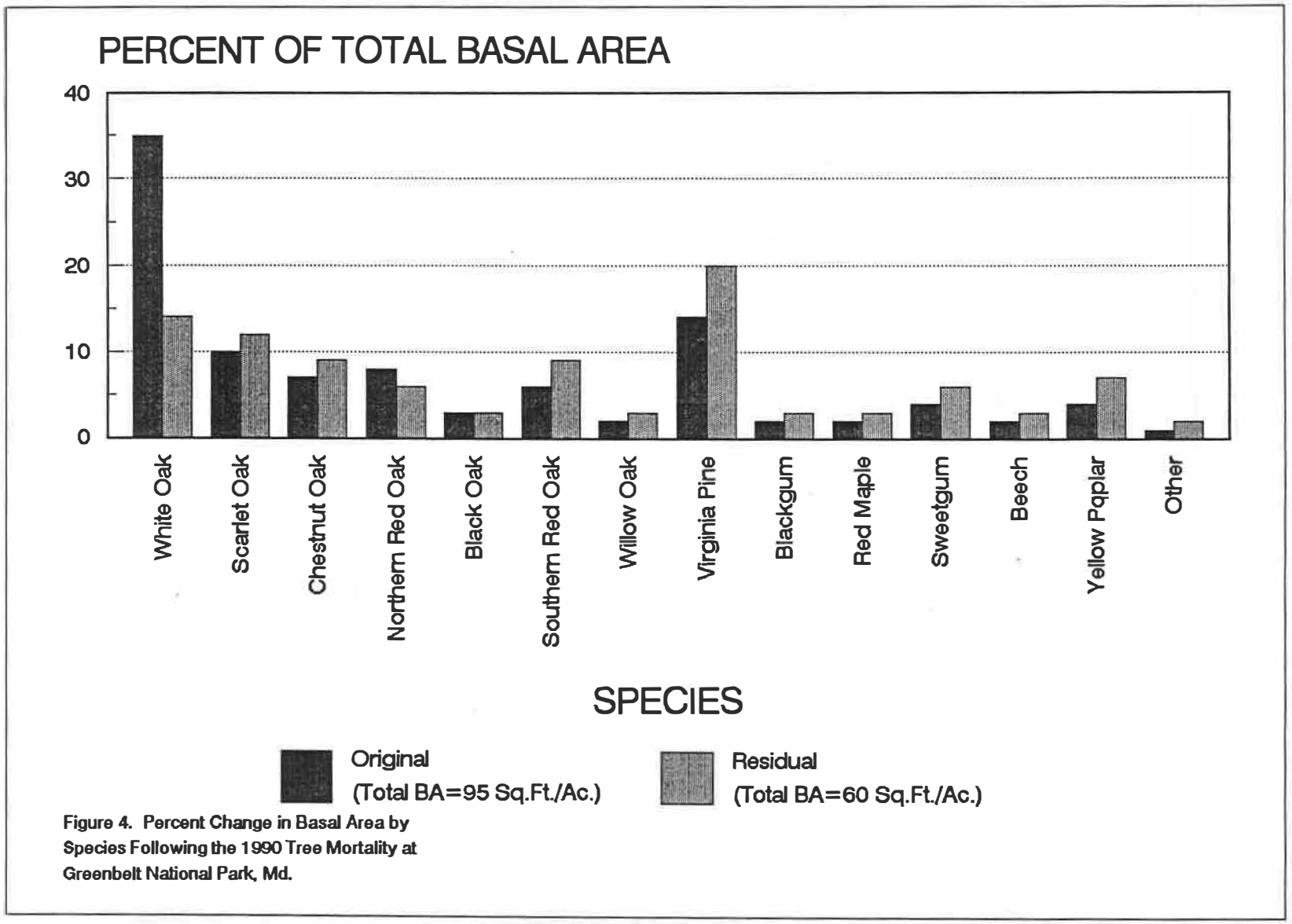

Figure 4. Percent Change in Basal Area by Species Following the 1990 Tree Mortality at Greenbelt National Park, Md.

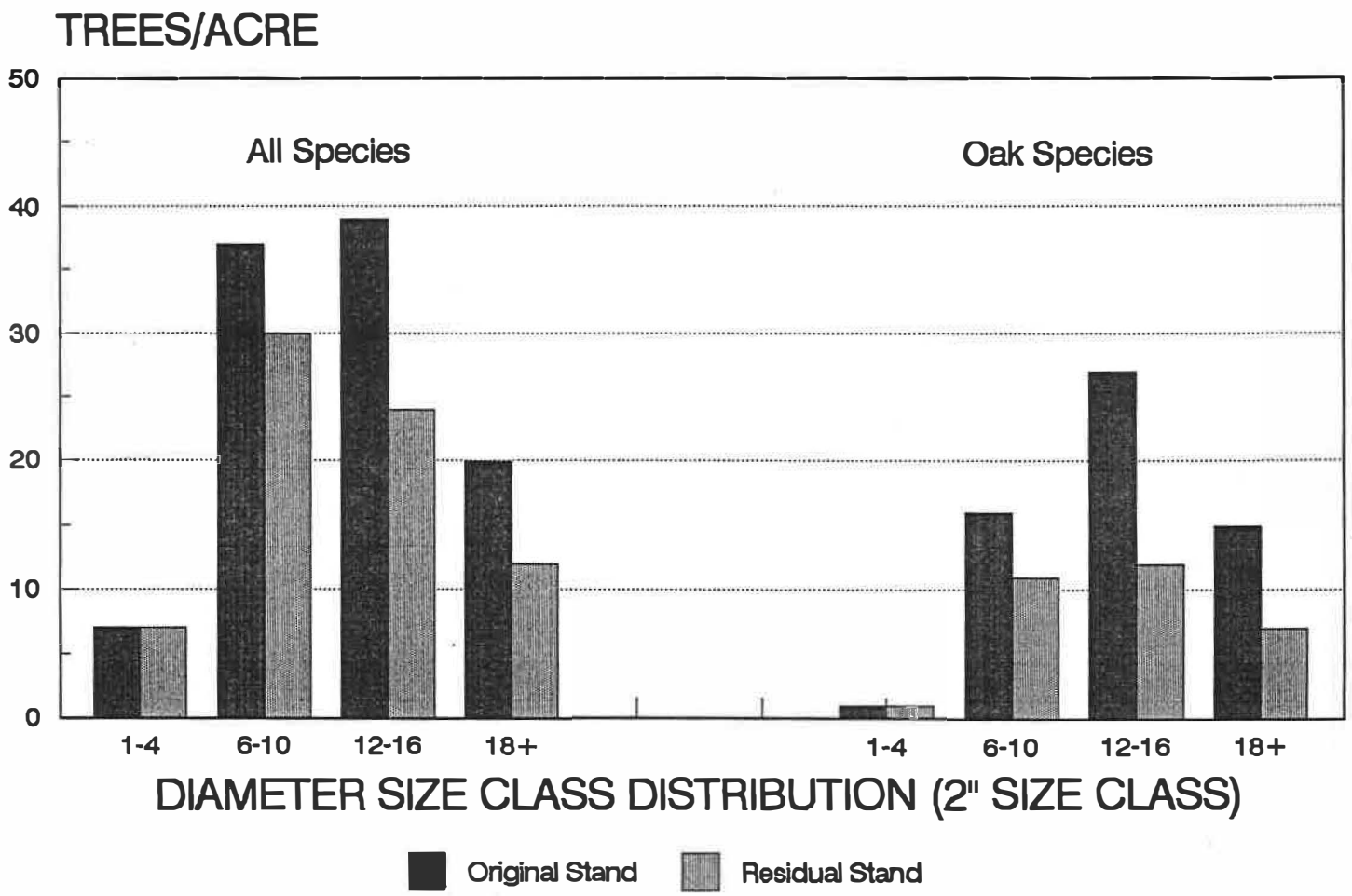

Figure 5. Affect of the 1990 Tree Mortality on the Size Class Distribution at Greenbelt National Park, Md.